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INJECTION MOLDING MACHINE ARRANGEMENT WITH AN INJECTION MOLDING
MACHINE AND AT LEAST ONE INTERNAL MACHINE CONTROL SYSTEM
[SPRITZGIESSMASCHINENANORDNUNG MIT EINER SPRITZGIESSMASCHINE UND
MINDESTENS EINEM INTERNEN MASCHINENSTEUERUNGSSYSTEM]

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The invention concerns an injection molding machine arrangement /1* with an injection molding machine and at least one internal machine control system, in particular with at least one SPS and/or actuators and/or sensors connected therewith, for computer-supported process monitoring and control of the injection molding machine.

Injection molding machine arrangements, which are controlled and monitored by machine control systems, preferably by computer-programmable controls (SPS), are known in the prior art. In addition, controlling and requesting process data via fixed cable networks or the Internet (EP 0 917 034 A1) connected to the injection molding machine arrangement, and external data processing devices again connected thereto are known. Thus these solutions known in the prior art are all connected to fixed installations, respectively cables between machine control system and nearby or remote maintenance work places.

Thus the object of the invention is to create an injection molding machine arrangement and a method for operating this injection molding machine arrangement, in which the above-mentioned disadvantages are eliminated. In this case it is particularly important to create a flexible solution usable in the vicinity of the injection machine arrangement.

This is achieved according to the invention by the fact that the injection molding machine arrangement has at least one - preferably

*Numbers in the margin indicate pagination in the foreign text.

bi-directional and/or real-time capable - wireless interface device for wireless data transmission from at least one external, preferably mobile, data processing device and/or to at least one external preferably mobile data transmission device.

The embodiment according to the invention thus permits data transmission between at least one external, preferably mobile data transmission device and the machine control system of an injection molding machine arrangement, without the external data processing device being connected by cable with the machine control system of /2 the injection molding machine. Next, in a simple embodiment the mass storage media (e.g. hard disks) usually mechanically integrated into the internal machine control system of an injection molding machine arrangement have a mobile connection via the wireless interface device of the injection molding machine arrangement according to the invention. In addition, the wireless interface device of the injection machine arrangement according to the invention and the wireless communication thus enabled with external, preferably mobile data processing devices offer a number of very flexible possibilities for optimizing data processing and data transmission steps in the case of injection molding machines. Some important possibilities are formulated in the subclaims.

It is particularly favorable that the - preferably bi-directional and/or real-time capable - interface device communicates directly with the external, preferably mobile data processing device without using

further data transmission devices. This embodiment is particularly designed for data communication in the immediate vicinity around the injection molding machine arrangement (e.g. production shop). This very flexible solution, which does not require permanent cables, also makes it possible for an external, preferably mobile data processing device to communicate, respectively exchange data with several injection machines simultaneously or sequentially.

Different versions are possible in the case of making the wireless interface device of the internal machine control system of the injection molding machine arrangement according to the invention. Thus the fact that the - preferably bi-directional and/or real-time capable - wireless interface device is an infrared interface, preferably with Infrared Data Association standard, is a favorable version. A further version is characterized by the fact that the - preferably bi-directional and/or real-time capable - wireless interface device is a radio device for sending and/or receiving electromagnetic radio signals.

In addition to these wireless interface devices based on infrared, respectively radio signals, other wireless transmission mechanisms preferably based on wave propagation, such as, for /3 example, electromagnetic waves in other frequency ranges are possible according to the invention, for example according to the "Bluetooth" standard.

There is currently a very fast development of external, preferably mobile, data processing devices on the market. Basically a large band width of external, preferably mobile, data processing devices can be used for making an injection molding machine arrangement. Preferred properties of these external, preferably mobile, data processing devices are that the external, preferably mobile, data processing device has at least one sending and receiving device - preferably and/or at least one microprocessor - and/or at least one memory and/or at least one current supply of its own, independent of the main power network, preferably a battery, and/or is portable.

Further favorable properties are that the external, preferably mobile, data processing device has at least one control unit - preferably keyboard and/or touch pad - and/or display and/or touch screen. Devices favorable for the application according to the invention currently on the market are, for example, so-called PDA's (Personal Digital Assistants), e.g. from the Palm Company or devices with "Bluetooth" interfaces or any other laptops, which have corresponding interface devices. Basically there is almost no limitation in the use of flexible data transport and data processing devices.

In addition to the named, preferably mobile, data processing devices, the use of the wireless interface device for controlling stationary devices, such as, for example a printer, is possible. In

addition, the communication between the internal machine control system and external modem or keyboards or control units of other machine devices etc. is conceivable.

Furthermore, in the case of a machine arrangement according to the invention it is particularly favorable if data can be transmitted preferably bi-directionally and/or in real time - between the - preferably bi-directional and/or real-time capable - wireless /4 interface device or the injection molding machine arrangement and the external preferably mobile data processing device. Basically a mass storage media of an external, preferably mobile, data processing device can be used for several injection molding machine arrangements in this way. Moreover, it is possible that the external mobile data processing device can be used very flexibly as a transport medium of data, e.g. between office and injection molding machine arrangement or between different injection molding machine arrangements. Another advantage is that process data can be transmitted from the internal machine control system of the injection molding machine arrangement in real time to an external, preferably mobile, data processing device, in order to be used there directly then as a basis for simulation processes or statistical evaluations. Then specific control orders can be transmitted immediately again from the external, preferably mobile, data processing device to the internal machine control system of the injection molding machine arrangement or different injection molding machine arrangements because of this data base by the

simulation or evaluation results. In this way a very rapid and flexible initiation of the, respectively a very rapid and flexible monitoring of the current production process is possible.

In this case it is particularly favorable that automatic detection and/or contact pick-up can be carried out between the - preferably bi-directional and/or real-time capable - wireless interface device of the injection molding machine arrangement and the external, preferably mobile, data processing device, if the external, preferably mobile, data processing device is in communication range of the wireless interface device of the injection molding machine arrangement. This embodiment thus permits that one or more external, preferably mobile, data processing devices automatically come in contact with at least one machine control system of at least one injection molding machine arrangement and in this way the transmission of data can be automated and performed quasi in passing.

In this case it is particularly favorable for preventing unauthorized access to data banks of the machine control system or for preventing unauthorized transmission of control orders to the machine control system that the injection molding control /5 arrangement - preferably automatically - checks authorization before - preferably bi-directionally and/or in real time - data can be exchanged with the external, preferably mobile, data processing device.

For monitoring the production processes a favorable version provides that process data can be transmitted from the preferably internal machine control system of the injection molding machine arrangement via the wireless - preferably bi-directional and/or real-time capable - interface device to the external, preferably mobile, data processing device wirelessly - preferably in real time.

On the other hand, it is also favorable that control orders - preferably in real time - can be transmitted from the external, preferably mobile, data processing device wirelessly via the wireless - preferably bi-directional and/or real-time capable - interface device to the injection molding machine arrangement.

In addition to the all-day process control and monitoring, favorable versions of embodiments also provide that the injection molding machine arrangement can be observed wirelessly via the wireless - preferably bi-directional and/or real-time capable - interface device. In addition it is provided that software - preferably control programs - be exchangeable wirelessly between the internal machine control system of the injection molding machine arrangement via the wireless - preferably bi-directional and/or real-time capable - interface direction and the external, preferably mobile, data processing device, preferably it is possible to perform version checking of the programs present on the devices communicating with one another.

In a favorable further development it is also provided that data and/or control orders can be transmitted from and/or to the preferably internal machine control system of the injection molding machine arrangement through the external, preferably mobile, data processing device, preferably at least one mobile radio telephone, via at least one mobile radio network, preferably in real time. In the case of this embodiment can thus be achieved via a mobile data processing device such as, for example, a mobile radio telephone, /6 which has the suitable interface for communication with the machine control system, data communication between the injection molding machine arrangement and a control computer located at any remote location with access to the mobile radio network. The external, preferably mobile, data processing device such as, for example, the mobile radio telephone in this case is used for data transmission, in which it communicates with the internal machine control system of the injection molding machine arrangement, for example via infrared or radio signals and with the external control computer located at any location via a mobile radio network.

Further features and details of the present invention are presented in the following description of the figures. Here:

Fig. 1 shows a schematic representation of a machine control device of an injection molding machine arrangement with a wireless interface device according to the invention, and

Fig. 2 shows a schematic representation of the connection of an injection molding machine arrangement with a mobile radio network.

In the specific embodiment in Fig. 1 the machine control system 16 of the injection molding machine arrangement 15 has wireless interface devices 1 in addition to other units. This consists of a controller 2 and a sending and receiving device 3, preferably antenna or infrared transmitter. The controller 3 of the wireless interface device 1 is connected via a central bus system 4, for example, a PC (programmable communication interface) bus, with the other components of the machine control system 16. The actual computer unit, consisting of a CPU (central processing unit) 6, the main memory (DRAM = dynamic random access memory) 7, and a graphic controller 8 with connected display 9, is connected to this bus system 4 via its own microcontroller ("North Bridge") 5.

The following further computer components also are, respectively can be, connected to the central bus system 4: one or more serial bus interface 10, that either correspond to an international standard, e.g. Ethernet IEEE 802.3, or are proprietary. IO assemblies 11 for digital and analogous actuators and sensors are connected via one /7 of the serial bus systems, which also must have real time capacity.

A further controller ("South Bridge") 12 connects additional computer components 13, such as mass storage HDD (hard disk drive), CD-ROM (= compact disk read only memory), SRAM (= static random access

memory), UART (universal asynchronous receivers and transmitters), etc. with the entire system.

The programs processed by the CPU 6 are loaded from the mass storage media 13 (see South Bridge) into the main memory 7 and executed from there. These programs consist of a main program (operating system) that is capable of executing a number of application programs in quasi-parallel fashion and within definite time limits in real time. This program also exercises control over, respectively observes the coordination tasks of all control components. Further, it consists of programs for observing the specific control tasks of injection molding machine 14 (application program) as well as programs for visualization of the process states.

Process states are detected by sensors (not shown here), transmitted via the IO assemblies 11 and the serial bus interface 10 to the control, and are ready for further processing to the control either in the main memory 7 or to mass memories 13. The control signals calculated by the control respectively CPU 6 are transmitted via the serial bus interface 10 to the output card of the IO assembly 11 and there control the connected actuators (also not shown here).

In order to be able to access these data from outside, these data are offered from servers of external or internal clients. In the case of the prior art, which can also be, but must not, realized here, via one of the serial bus systems (e.g. Ethernet) (via HTTP server and

Internet Browse) or can take place according to the invention via the incorporated wireless interface device 1.

Intelligent terminals, that the operator or service personnel carry with them, are designed as communication partners of the machine control system 16 of the injection molding machine arrangement 15, as external, preferably mobile, data processing devices 18. Typical devices are so-called PDA's (Personal Digital Assistant) e.g. from the Palm Company. Bluetooth for the radio range and IrDA for the infrared range are available as further technologies, respectively standards. /8

As shown in Fig. 1, mass memories 13 are integrated into the control system via the "South Bridge" 12. These mass storage media on the one hand are used for storing the programs (operating system, application programs, visualization programs), on the other hand they also store parameter data sets, that contain the tool-specific parametrization of the application programs.

External, preferably mobile, data processing devices 18 are tied in by bringing them into the sending range of a sending and receiving device 3 of the wireless interface 1 of the injection molding machine arrangement 15. The two devices start automatic connection via a definite communication protocol, the external, preferably mobile, device 18 being detected as a provider of a data storage service.

The method of "spontaneous networking", that is, the devices themselves seek their next communication partner, respectively service

provider (e.g. printer or fax equipment) during their transport, and start connection with them independently, is known by the term "pervasive computing".

Areas of application for this are:

- data storage media for receiving/transmitting parameter data sets

- transport of user information or outside information to the injection molding machine: e.g. data could be transmitted from a material data bank stored on the mobile device 18 as a support of process optimization temporarily to the machine control system 16;

- loading service data, which were collected by the control (in real time), onto the intelligent mobile terminal 18, where they can immediately influence statistics, or analyzed in another way.

- access control: access to machine data can be connected to /9 the serial numbers of the mobile device 18. This leaves practically no room for manipulation and prevents unauthorized data access.

- including further intelligent devices into the area of utilization of the injection molding machine, for example using printers, keyboards, ...

In general it is advantageous that an external, preferably mobile, intelligent data processing device 18 is prepared by the user on site for analysis and advice functions, that he can use for all machines equally. This saves distributing these functions to all machines in a decentralized way (version problems). Furthermore, it

is used for concentrating data collected ad hoc by the user taking account of circumstances existing on site and thus obtaining an overview of the totality of the injection molding machine arrangements 15. Basically these advantages are largely also valid for permanently interconnected injection molding machine arrangements, but the concentrated data then are available on site only by proxy in the office. In the mobile case according to the invention, these data are available on site. The decisions derived from these data can be made in better quality taking account of the local and real circumstances.

Moreover, each machine operator can carry his own "software pool" with him on his external mobile data processing device 18 and configure freely according to his personal needs.

As shown in Fig. 2, another version also provides that the machine control system 16 of an injection molding machine arrangement 15 communicates via an external, preferably mobile, data processing device 18 and a mobile radio network with an external control computer 20 located at any location. In this case it is provided that the external control computer 20 is connected with a mobile radio sender/receiver 19 for data transmission via mobile radio network. In the case of this version it is particularly favorable that the external data processing device 18 is made as a mobile radio telephone. This mobile radio telephone communicates in the function assigned to it in this way with the interface device 1 of the

injection molding machine arrangement 15, e.g. via infrared or radio, and thereby transmits or receives data to or from the external control computer 20 via a mobile radio network. This version shown /10 in Fig. 2 thus enables data communication between an injection molding machine arrangement 15 and an external control computer 20 by means of a mobile radio network with the use of an external, preferably mobile, data processing device 18 as a relay station.

Claims

/11

1. An injection molding machine arrangement with an injection molding machine and with at least one, in particular internal, machine control system, in particular with at least one SPS and/or actuators and/or sensors connected therewith, for computer-controlled process monitoring and control of the injection molding machine, wherein the injection molding machine arrangement (15) has at least one - preferably bi-directional and/or real-time capable - wireless interface device (1) for wireless data transmission of at least one external, preferably mobile, data processing device (18) and/or at least one external preferably mobile data processing device (18).

2. The injection molding machine arrangement according to Claim 1, wherein the - preferably bi-directional and/or real-time capable - interface device (1) directly communicates, without using further data processing devices, with the external, preferably mobile, data processing device (18).

3. The injection molding machine arrangement according to one of Claims 1 or 2, wherein the - preferably bi-directional and/or real-time - wireless interface device (1) is an infrared interface - preferably with IrDA standard.

4. The injection molding machine arrangement according to one of Claims 1 to 3, wherein the -preferably bi-directional and/or real-time - wireless interface device (1) is a radio device for sending and/or receiving electromagnetic radio signals.

5. The injection molding machine arrangement according to one of Claims 1 to 4, wherein the external, preferably mobile, data processing device (18) has at least one sending and receiving device - preferably and/or at least one microprocessor - and/or at least one storage medium and/or at least one current supply of its own, /12 independent of the power network - preferably a battery - and/or is portable.

6. The injection molding machine arrangement according to one of the Claims 1 to 5, wherein the external, preferably mobile, data processing device (18) has at least one control unit - preferably keyboard and/or touch pad - and/or display and/or touch screen.

7. The injection molding machine arrangement according to one of Claims 1 to 7, wherein the external data processing device (18) is a stationary device - preferably a printer -.

8. The injection molding machine arrangement according to one of the Claims 1 to 7, wherein data can be transmitted - preferably bi-

directionally and/or in real time - between the - preferably bi-directional and/or real-time capable - wireless interface direction (1) of the injection molding machine arrangement (15) and the external, preferably mobile, data processing device (18).

9. The injection molding machine arrangement according to one of Claims 1 to 8, wherein an automatic detection and/or contact pick-up can be carried out between the - preferably bi-directional and/or real-time capable - wireless interface device (1) of the injection molding machine arrangement (15) and the external, preferably mobile, data processing device (18), when the external, preferably mobile, data processing device (18) is in communication range of the wireless interface device (1) of the injection molding machine arrangement (15).

10. The injection molding machine arrangement according to one of Claims 1 to 9, wherein the injection molding machine arrangement (15) - preferably automatically - performs authorization checking, before - preferably bi-directionally or in real time - data can be /13 exchanged with the - preferably mobile - external data processing device (18).

11. The injection molding machine arrangement according to one of Claims 1 to 10, wherein process data from the preferably internal machine control system (16) of the injection molding machine arrangement (15) can be wirelessly transmitted via the wireless - preferably bi-directional and/or real-time capable - interface device

(1) to the - preferably mobile - external data processing device (18)
- preferably in real time.

12. The injection molding machine arrangement according to one of the Claims 1 to 11, wherein control orders can be wirelessly transmitted - preferably in real time - from the external, preferably mobile, data processing device (18) via the wireless - preferably bi-directional and/or real-time capable - interface device (1) to the injection molding machine arrangement (15).

13. The injection molding machine arrangement according to one of Claims 1 to 12, wherein the injection molding machine arrangement (15) can be wirelessly observed via the wireless - preferably bi-directional and/or real-time capable - interface device (1).

14. The injection molding machine arrangement according to one of Claims 1 to 13, wherein software - preferably control programs - can be exchanged wirelessly between the internal machine control system (16) of the injection molding machine arrangement (15) via the wireless - preferably bi-directional and/or real-time capable - interface device (1) and the external, preferably mobile, data processing device (18), - preferably it being possible to check versions of programs existing on one of the devices (15, 18) communicating with one another.

15. The injection molding machine arrangement according to one of Claims 1 to 14, wherein data and/or control orders can be transmitted

from and/or to the preferably internal machine controlling system (16)
of the injection molding machine arrangement
(15) through the external, preferably mobile, data processing /14
device (18) - preferably at least a mobile telephone - via at least
one mobile radio network - preferably in real time.

Fig. 1

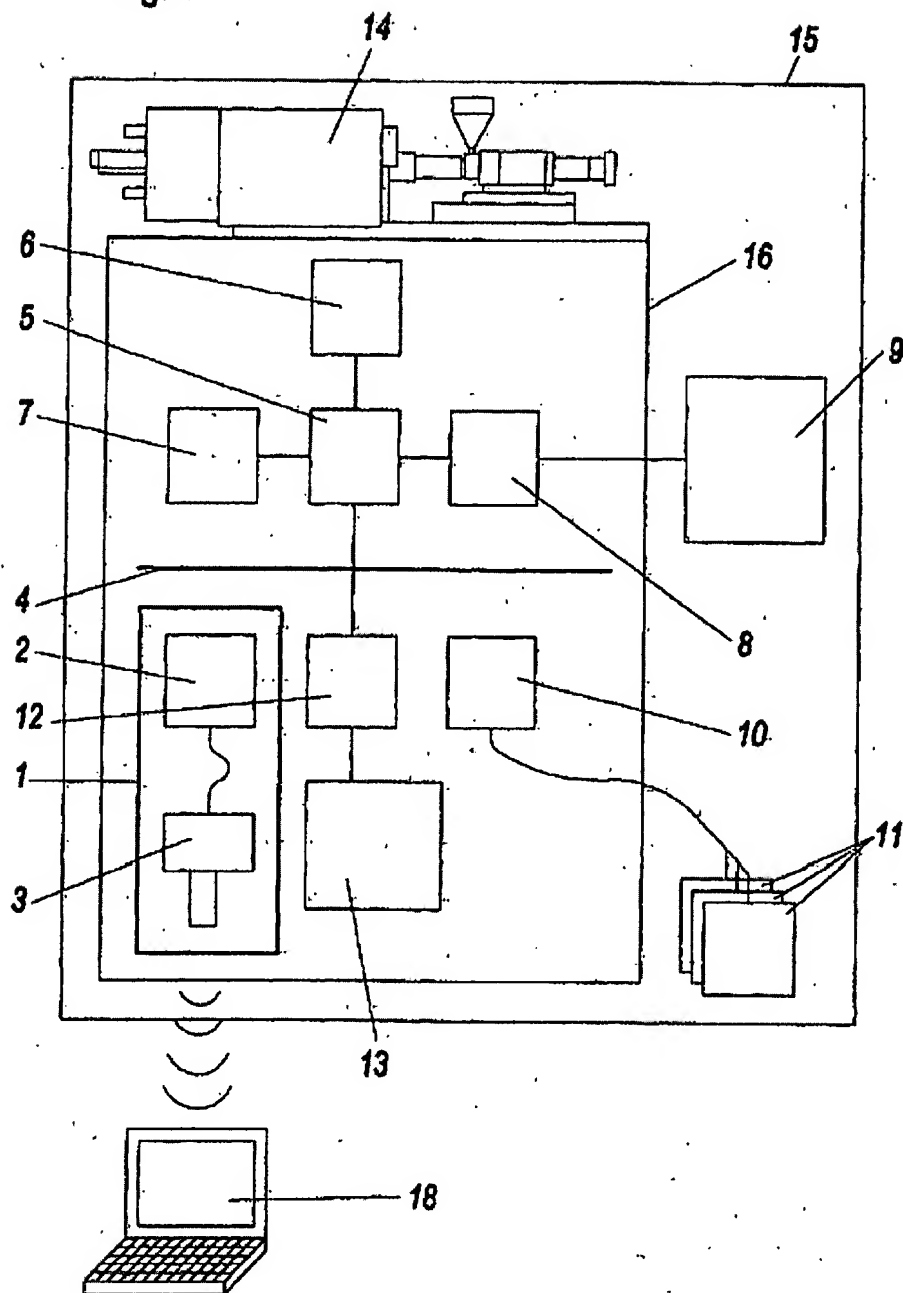


Fig. 2

